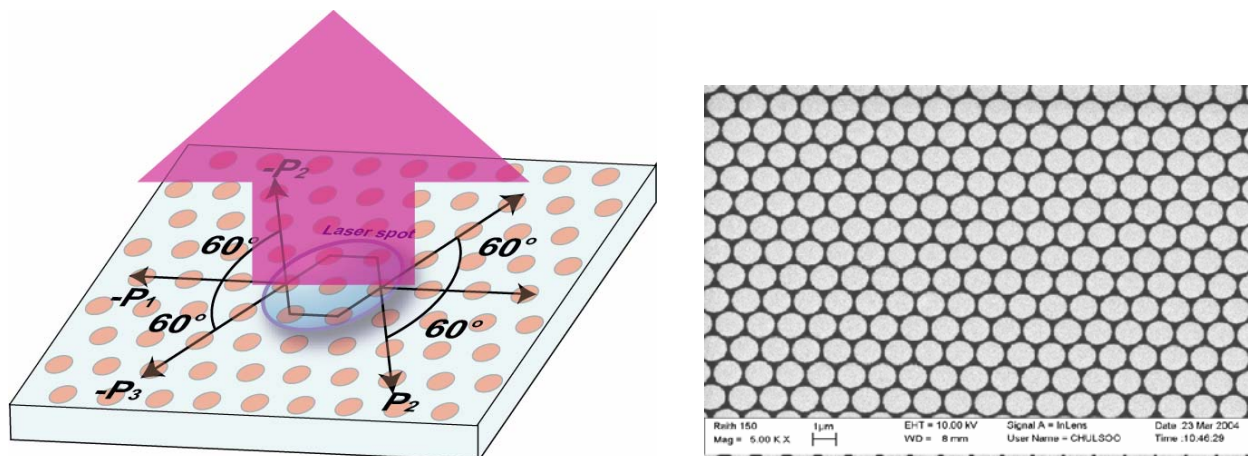


Surface Emitting Photonic-Crystal Distributed-Feedback Lasers



Schematic and scanning electron micrograph of the surface-emitting PCDFB laser with the major in-plane propagation directions and the direction of the emitted light shown.

DESCRIPTION:

Semiconductor lasers that offer a combination of high output power and low beam divergence are needed for a variety of applications ranging from free-space communications to infrared countermeasures. Devices that can combine these characteristics with a circular output beam will almost certainly need to employ a surface-emitting geometry, whereby the light is collected from the top surface rather than a cleaved facet. Researchers at Naval Research Laboratory have proposed a scheme in which coherent laser light can be emitted from an extremely large surface area without the benefit of an external mirror or any means to confine the light laterally. The concept employs a higher-order hexagonal diffraction grating that is etched into the semiconductor laser optical waveguide. Three distinct diffraction processes enforce optical coherence in the plane of the device, whereas a fourth process couples the light out in the vertical direction. Detailed simulations reveal a non-trivial yet experimentally accessible parameter space for the grating that allows near-diffraction-limited operation for emitting diameters on the order of one millimeter. This surface-emitting photonic-crystal distributed-feedback (SE PCDFB) laser has been reduced to practice using optically pumped antimonide “W” active regions designed for emission in the mid-infrared. The emitted light is transmitted through a narrow far-field aperture for pump spot diameters of up to half a millimeter.

ADVANTAGES/FEATURES:

- No need for cleaved facets or other device definition
- Circular, near-diffraction-limited output beam
- Potential for single-mode spectral operation
- Heat load for a given output power is reduced owing to the large device area
- Licensable under patent US 6,826,223

APPLICATIONS:

- Remote chemical and biological sensing
- Free-space optical communications
- Infrared countermeasures
- Infrared scene projection

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